IN THE SPECIFICATION:

Please amend paragraph **[0002]** as follows:

[0002] Field of the Invention: This invention relates generally to semiconductor device manufacturing. More particularly, the present invention is directed to methods and apparatus for handling solder balls in forming ~~ball grid arrays~~ ball-grid-arrays (BGAs).

Please amend paragraph **[0004]** as follows:

[0004] Interconnection of discrete semiconductor packages onto a substrate such as a printed circuit board (PCB) is often accomplished with solder preforms ~~having~~ having a generally spherical or other shape. In a process using a ball-grid-array (BGA), spherical solder balls are attached to prefluxed metallized locations on a workpiece such as a circuit board or a semiconductor device. The workpiece is then heated to reflow the solder balls, and the solder balls become attached to the metallized locations during subsequent cooling. A semiconductor package or circuit board having a corresponding but reversed pattern of connection sites may then be aligned with the BGA and bonded to it by controlled heating in a reflow furnace.

Please amend paragraph **[0007]** as follows:

[0007] Solder bumps may be formed on a workpiece by processes of evaporation, electroplating, stencil printing, and serial methods. Each of these processes has particular limitations. United States Patent No. 5,672,542 ~~of~~ to Schwiebert et al. is an example of a modified stencil printing process.

Please amend paragraph **[0008]** as follows:

[0008] In United States Patent No. 3,716,907 ~~of~~ to Anderson, the use of germanium hemispheres as conductive contacts is disclosed. The germanium hemispheres are connected to the substrates with solder.

Please amend paragraph **[0011]** as follows:

[0011] In United States Patent No. 5,620,927 ~~of~~ to Lee, a template with an array of through-holes is placed on the workpiece and solder balls are introduced into the holes by rolling the solder balls across the workpiece surface. The apparatus may be installed on a tilt table to encourage filling of all holes. In United States Patent No. 4,871,110 ~~of~~ to Fukasawa et al., a template having an array of holes is placed on a ball holder with a like array of smaller holes to which vacuum is applied and over which solder balls are rolled. After the array is filled with solder balls, the template and ball holder with balls are removed and the exposed ends of the balls attached to a substrate ~~by~~ by, e.g., reflow. The template and ball holder are then pulled from the substrate, leaving a ball-grid-array ready for attachment to another substrate or workpiece. A vacuum system is required, and there is no easy way to replace a solder ball onto a bond pad to which a ball did not become attached (i.e., ~~missing~~ a missing ball).

Please amend paragraph **[0012]** as follows:

[0012] As shown in United States Patent No. 3,719,981, an array of solder balls is arranged on the tacky surface of a pressure sensitive (PS) tape for alignment through a template to solder bumps on a wafer. After thermal reflow, the template and tape are removed.

Please amend paragraph **[0013]** as follows:

[0013] The use of a template for forming solder bumps or "balls" on a workpiece from flux and solder pieces is disclosed in United States Patent No. 5,492,266 ~~of~~ to Hoebener et al.

Please amend paragraph **[0014]** as follows:

[0014] In United States Patent No. 5,431,332 ~~of~~ to Kirby et al., a template is placed over the bond pads of a substrate, solder balls are poured over the template, and an air knife "sweeps" the surface free of excess solder balls.

Please amend paragraph **[0015]** as follows:

[0015] The use of a ball pick-up tool with an array of vacuum suction ball retainers to pull up balls from an underlying reservoir and place them on a substrate is disclosed in United States Patent No. 5,088,639 ~~of~~ to Gondotra et al., United States Patent No. 5,284,287 ~~of~~ to Wilson et al., United States Patent No. 5,445,313 ~~of~~ to Boyd et al., United States Patent No. 5,467,913 ~~of~~ to Nemekawa et al., United States Patent No. 5,615,823 ~~of~~ to Noda et al., United States Patent No. 5,680,984 ~~of~~ to Sakemi, United States Patent No. 5,685,477 ~~of~~ to Mallik et al., United States Patent No. 5,687,901 ~~of~~ to Hoshiba et al., and United States Patent No. 5,695,667 ~~of~~ to Eguchi et al. It is known in the art that shutting off the vacuum to release each ball onto the substrate is not always successful, and sometimes balls remain attached to the pick-up tool. Again, there is no easy way to replace a missing ball except with a single ball pick-up tool.

Please amend paragraph **[0016]** as follows:

[0016] United States Patent No. 5,506,385 ~~of~~ to Murakami et al. discloses the use of a single manipulable suction head for picking up a solder ball, moving it to a position above a fluxed contact pad on a substrate, and depositing it on the contact pad. Because of the high number of repetitive actions in separate placement of each ball, ball placement is time consuming.

Please amend paragraph **[0017]** as follows:

[0017] United States Patent No. 5,695,667 shows a single ball suction head which is used to place a solder ball on a contact pad which is missing a solder ball of a ball-grid-array.

Please amend paragraph **[0018]** as follows:

[0018] The application of flux to solder balls held in a vacuum apparatus by dipping the balls into a flux reservoir is taught in United States Patent No. 5,088,639 ~~of~~ to Gondotra et al. and in United States Patent No. 5,284,287 ~~of~~ to Wilson et al.

Please amend paragraph **[0019]** as follows:

[0019] The use of ultrasonic vibration to cause solder ball movement in the ball reservoir, and to remove excess solder balls from a vacuum pick-up tool, is taught in United States Patent No. 5,687,901 ~~of~~ to Hoshiba et al.

Please amend paragraph **[0021]** as follows:

[0021] The apparatus includes a stencil plate or screen overlying the substrate, wherein the stencil plate is parallel to and slightly spaced from the substrate. The stencil plate has an array of through-holes corresponding to a desired placement pattern of conductive spheres on the substrate. The invention also includes ball supply apparatus for providing conductive spheres to the stencil plate, wherein all through-holes in the stencil plate are filled with one, and only one, sphere. Spheres placed into the through-holes of the stencil plate drop by gravity to the substrate for retention by pre-applied flux or by depressed bond pads. Each through-hole is slightly larger than a sphere and constrains a sphere on the substrate until the substrate and stencil plate are further ~~separated~~ separated, e.g., for solder reflow. The stencil plate thickness and proximity to the substrate prevent more than one ball from entering each through-hole of the stencil plate.

Please amend paragraph **[0022]** as follows:

[0022] A first embodiment of a ball supplying apparatus is a sphere-retaining hopper with a lower opening through which spheres may drop into through-holes of the stencil plate and thence onto the substrate surface. The hopper is closely spaced from the stencil plate to maintain control over all the spheres therein. Sphere placement is accomplished by horizontal movement of the hopper across the through-hole pattern of the stencil plate, filling each through-hole with ~~one~~ one, and only ~~one~~ one, sphere. As the hopper moves, only the spheres dropping into the through-holes, one to a through-hole, can escape from the hopper. The numbers of spheres passing over each through-hole ensure that each hole is filled, but a higher degree of assurance can be obtained by making several passes.

Please amend paragraph **[0025]** as follows:

[0025] FIG. 1 is a perspective exploded view of an exemplary apparatus of the invention for placing conductive spheres on a substrate;

Please amend paragraph **[0026]** as follows:

[0026] FIG. 2 is a sectional side view of a substrate and exemplary screen for applying flux ~~to the~~ to bond pads in a step of a method of the invention for placing conductive spheres on a substrate;

Please amend paragraph **[0028]** as follows:

[0028] FIG. 4 is a sectional side view of a sphere placement apparatus of the invention showing spheres placed ~~on the~~ on bond pads of a substrate, as taken along section line 4-4 of FIG. 1;

Please amend paragraph **[0029]** as follows:

[0029] FIG. 5 is a sectional side view of a substrate having conductive spheres placed ~~on the~~ on bond pads of the substrate in accordance with a sphere placement method of the invention;

Please amend paragraph **[0030]** as follows:

[0030] FIG. 6 is a sectional side view of a substrate having conductive spheres placed ~~on the~~ on bond pads of the substrate and reflowed in accordance with a method of the invention;

Please amend paragraph **[0034]** as follows:

[0034] FIG. 10 is a cross-sectional end view of another embodiment of a hopper of the invention, as taken along section line 10-10 of FIG. 1;

Please amend paragraph **[0061]** as follows:

[0061] The methods described herein present many advantages to the BGA formation process, including higher reliability, lower cost, reduced ball wastage, etc. The apparatus and methods are relatively simple, yet provide a great deal of flexibility in substrate type, sphere size, sphere composition, etc. Non-filling of a through-hole of the stencil plate is easily cured by moving the sphere ~~supply~~ placement apparatus through another cycle. There is no need for using a single-head ball picker to place a single ball as noted in the prior art.

Please amend paragraph **[0062]** as follows:

[0062] This invention may be embodied in several forms without departing from the spirit of essential characteristics of the invention. The embodiments as described herein are therefore intended to be only illustrative and not restrictive, and the scope of the invention is defined by the appended claims rather than the preceding description, and all variations that fall within the metes and bounds of the subject matter claimed, or are equivalent thereto, are therefore intended to be embraced by the following ~~claims:~~ claims.